

THE DIAGNOSIS OF PERITONITIS AND PERITONEAL TRANSUDATES IN INFANTS BY MEANS OF ABDOMINAL PUNCTURE WITH THE CAPILLARY TUBE.

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IN a preliminary communication a method was demonstrated which had been used in the diagnosis of a few cases of peritonitis and peritoneal effusion.¹ Since then the technic has been modified and the method has passed the experimental stage.

The original procedure consists in puncturing the skin with a metal needle, and through the opening thus made, inserting into the peritoneal cavity a glass needle with a capillary bore. Fluid rises in the glass tubing by the force of capillarity. In order to obtain larger amounts the tube was bent and a bulb was blown for the collection of the fluid. The objections to using glass needles are obvious, and the only advantage that still remains over the modification to be described is that a larger amount of fluid may be collected in the bulb of the glass needle. This advantage is insignificant compared with the greater safety in the use of the metal cannula, trocar and capillary tubing.

Only the latest, and thus far the most satisfactory, instrument, will be described.² It consists of a trocar-cannula and glass capillary tubing, and is shown in diagram in Figs. 1 and 2. The cannula is held by a handle and the shoulder is as short as it can be made. The shaft of the cannula is 17 gauge and $\frac{1}{2}$ inch in length. It has a sharp beveled point, and the trocar is made to correspond.³

Most of the capillary tubes were prepared by the author from glass tubing 4 mm. in diameter. This tubing was drawn out in the Bunsen flame and varied in thickness. Only those parts were used that fitted the shoulder, or rather the proximal part, of the shaft, and the tubing was cut off so as to protrude 1 or 2 mm. from the end of the cannula. The purpose of this technic is to prevent breaking the capillary tube within the peritoneal cavity. The cannula with the capillary tube prepared in this way is illustrated diagrammatically in Fig. 3. The capillary tube impinges upon the wall of the cannula at A. After the tubing is safely inserted into the cannula as far as it will go a break, if it occurs at all, will take

¹ Denzer, B. S.: *Am. Jour. Dis. Children*, August, 1920, 20, 113.

² The instrument was made by the Randall Faichney Company, of Boston, Mass.

³ A cannula with a flat end and trocar with an arrow-head point, similar to the larger instruments for abdominal paracentesis, was tried but was found unsatisfactory.

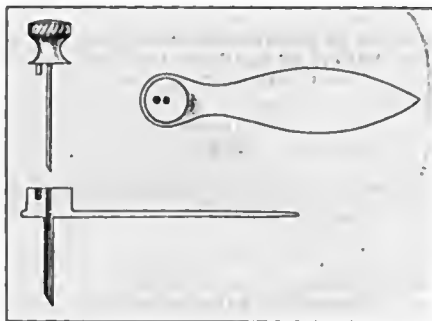


FIG. 1.—Trocar and cannula and top view of cannula. Semidiagrammatic cross-section.

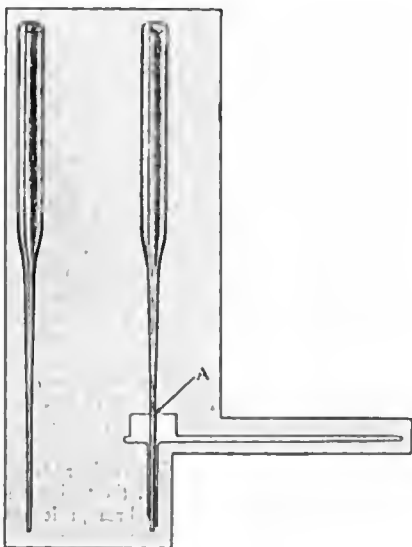


FIG. 2

FIG. 3

FIG. 2.—Capillary tube as prepared by author.

FIG. 3.—Cross-section of capillary tube fixed in cannula at A.

place above the point *A*, and the lower fragment, firmly fixed in the shaft, can be withdrawn with the cannula. Some of the capillary tubing was prepared by glass blowers (Fig. 4).

When glass tubing is used repeatedly the utmost precautions are necessary to obtain clean surfaces. As capillarity depends upon the capacity of the liquid to moisten the surface of the tube a minute film of fatty material might check the rising column of fluid. Cleaning fluid, hot water, alcohol and ether are used in obtaining clean glassware.

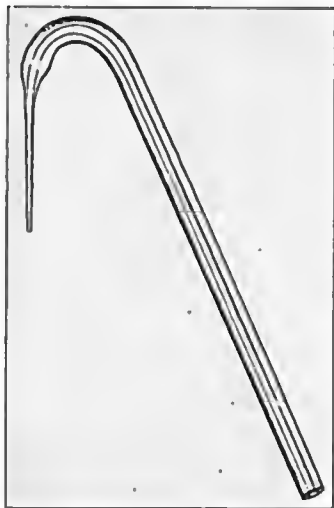


FIG. 4.—Capillary tube prepared by glass-blower.

The technic with the trocar-cannula and capillary tube is as follows: After sterilization of the skin and the usual precautions to determine bladder distention the point of the trocar-cannula is thrust through the skin and into the peritoneal cavity. The trocar is withdrawn and the capillary tube inserted as far as it will go. It is advisable to wait a few minutes and turn the needle in various directions before concluding that there is no fluid. Possibly a bit of omentum or the wall of the intestine may temporarily block the capillary tube; or when there is only a small amount of fluid this momentary wait and the straining and crying of the infant may distribute it over the entire peritoneal cavity. Any place on the abdomen except those parts covering a solid viscus may be used.

As a rule the midline just below the umbilicus is the site chosen, though punctures have been done in the iliac fossæ.

Peritonitis. The peculiar difficulties encountered in the diagnosis of peritonitis in infancy are too well recognized to demand lengthy discussion. Some of the classical signs and symptoms of peritonitis in adult life, such as pain, localized tenderness, distention and paralytic ileus, are either absent or difficult to elicit, and even when present they may be ascribed to minor gastro-intestinal disturbances, of which they are likewise characteristic signs. Standard textbooks on pediatrics and special studies on peritonitis in infancy⁴ emphasize these difficulties. In 5 cases abdominal puncture with the capillary tube has been used in the diagnosis of peritonitis.

CASE I.—Edward T., a colored boy, aged three years, was admitted to the pediatric service of the New York Nursery and Child's Hospital on April 20, 1920. No history was obtainable. On admission the temperature was 103° and thereafter showed wide variations,—from 2° to 6°. Chest signs and a positive von Pirquet pointed to pulmonary tuberculosis and the septic type of temperature suggested generalized tuberculous infection as well. On May 5, two weeks after admission, abdominal tenderness was first noted. The abdominal signs, though variable, became more and more definite, but the generalized tuberculosis rendered the diagnosis of acute peritonitis uncertain. On May 16 and 17 vomiting occurred, and on May 17 an abdominal puncture with the capillary tube was done. Whitish fluid rose in the tube and smears showed pus cells and Gram-positive cocci in chains. From a blood culture taken the same day a hemolytic streptococcus was grown. On May 18 a laparotomy was performed by Dr. Truesdale.

There was fluid pus in the peritoneal cavity; the appendix was swollen and red, but not ruptured. The child died the same day, and at autopsy generalized tuberculosis and purulent peritonitis were found.

CASE II.—Baby L., a colored infant, aged two months, weighing six pounds six ounces, was admitted to the hospital on July 19, 1920. As the baby was a foundling the history was incomplete. At the first examination, Dr. Anderson, the resident physician, made the following note: "The baby presented the usual picture of a true marantic—worn, anxious expression; thin, emaciated body; dry and inelastic skin." At first the baby's abdomen was distended, but during the twenty-four hours after admission it became distinctly softer. Marasmus, with the possibility of luetic infection, was the diagnosis considered.

⁴ Abt, I. A.: *New York Med. Jour.*, 1917, 105, 769. Dowd, C. A.: *Ann. Surg.*, 1908, 48, 821.

Abdominal puncture was done with the glass needle. A white milky fluid rose in the tube and showed on smear Gram-positive cocci in chains. The following day a laparotomy was performed. The baby's condition was too critical to permit anything more than the evacuation of a large quantity of pus and drainage of the peritoneal cavity. Death occurred on the day of operation. The autopsy showed a diffuse purulent peritonitis. No focus of infection or portal of entry could be found, and the case must be classified as a so-called idiopathic peritonitis in infancy.

This case is particularly interesting because there were no signs of peritonitis. An abdominal tap was done merely because this procedure had been adopted in all acutely ill cases when the diagnosis was in doubt. Baby L. typifies peritonitis in early infancy. Such infants show the signs of marasmus only, and there is nothing either in the history or examination to direct attention to the abdomen. Confronted with this problem the clinician cannot find adequate grounds for suspecting peritonitis; at the same time he cannot exclude such a possibility. Under these circumstances a procedure that reveals the presence of an exudate or gives assurance of its absence may be very helpful.

CASE III.—Baby V., an infant, aged two months, was admitted to the hospital on January 20, 1921, suffering from a lobar pneumonia of three days' duration. On January 27 an empyema of the right chest was discovered and drainage instituted. The following day the abdomen was distended and an abdominal puncture was done. Purulent fluid was obtained and Gram-positive cocci in pairs were found on a smear. The baby's condition was most critical and the usual therapeutic measures offered little hope. At the suggestion of Dr. Witt, of the resident house staff, 25 cc of antipneumococcus serum, Type I, were injected into the peritoneal cavity. The child died the same day, but an autopsy could not be obtained. The culture of the peritoneal fluid developed what was apparently a pneumococcus, but a contaminating organism prevented its isolation and typing.

CASE IV.—Baby M. was delivered on the obstetrical service of the New York Nursery and Child's Hospital February 26, 1921, weighing at birth six pounds thirteen ounces. The infant was transferred to the pediatric service, with a history of a steady decline in weight, refusal of food, vomiting and abdominal distention. After temporary improvement these symptoms recurred, and in addition, on March 21, pus was noted exuding from the umbilicus. The right iliac fossa was chosen as the site for the abdominal tap in order to avoid contamination by the purulent process localized about the umbilicus. Purulent fluid was obtained, but no organisms could be found on the smear, and the culture was sterile. Operation was

considered inadvisable and the baby died on March 24. At autopsy the ascending colon was found to be covered with loose vascular fibrinous adhesions—a localized plastic peritonitis. Whether there was also a generalized peritonitis could not be determined because of the flooding of the abdominal cavity by the intestinal contents, due to a rupture of the duodenum.

CASE V.—Francis R., an infant, aged two months, was admitted to the hospital on March 28, 1921, because of vomiting, refusal of food and an infected umbilicus. On examination the umbilicus was found to be red; the edges pouted and a drop of pus could be expressed. A mass was felt surrounding the umbilicus and extending toward the left flank. An abdominal tap was done. Very little fluid was obtained and two capillary tubes had to be passed into the cannula to get sufficient exudate for two smears and a culture. The smears were crowded with pus cells and a very few organisms in pairs were found. A laparotomy was performed. The peritoneum was found to be thick and indurated, but *there was apparently no free fluid exudate*. The cells of intestine were very red and injected and covered with a loose fibrin. One pole of the spleen was adherent to the peritoneum in the umbilical region and a probe could be passed through the infected umbilicus into the peritoneal cavity. The abdomen was drained. The child died on the day on which he was operated, but an autopsy could not be obtained.

Abdominal puncture in this case was particularly instructive, in that it demonstrated how small an exudate may be revealed by the capillary tube. Although enough fluid was obtained with the capillary tube for smears and culture no free fluid was found at operation but merely a loose edematous fibrin covering the intestinal coils.

The therapy of peritonitis in infancy is extremely unsatisfactory. Indeed, many cases are discovered only at autopsy. The procedure suggested offers the hope of early diagnosis, and this, in turn, may develop more adequate therapy.

Marasmus. Fluid was found by abdominal puncture in the peritoneal cavity in 7 of 12 marantic infants (Chart I). As a rule the fluid was clear; only those specimens that contained 1700 or more cells showed a granular turbidity. There is nothing characteristic concerning the cellular elements, which are chiefly lymphocytic. The albuminous content, as judged by the appearance of the smears, must be low; the picture is quite different from that of many pus cells in a heavy albuminous matrix observed in peritonitis.

No reference to an excess of peritoneal fluid in marasmus could be found in the literature.⁵ It is hardly conceivable that the occur-

⁵ Finkelstein and others mention the occurrence of "hydrops," but this refers to a subcutaneous accumulation of fluid.

CHART I.—ABDOMINAL TAP IN MARASMIUS.

Name.	Age.	Weight.	Diagnosis in addition to marasmus.	Condition of abdomen.	Result of tap.	Cell count.	Remarks.
Virginio K.	4	4	.....	Scaphoid	0		
Susan H.	5	8½	Tuberculosis	Not distended	0		
John M.	2½	5½	.....	Slight distention	0		
John S.	4½	8½	Intoxication	Not distended	0		
Lucinde, P.	3½	7½	.....	Not distended	0		
James P.	3½	5½	.....	Flat	+	860 cells per c.mm.; 100 counted, all lymphocytes	
Agnes H.	3	6½	.....	.....	0	.....	Two introvenous ood one intraperitoneal injection before tap.
Aug. 4, 1920	3½	6	.....	Slight distention	+	19 cells per c.mm.; large epithelial? cells	No paracoteral fluids for three weeks prior to tap.
Aug. 18, 1920	4	5½	.....	.....	+	2600 cells per c.mm.; polynucleors, 40 per cent; lymphocytes ood "epithelial," 60	Two hypodermodyses and one introvenous but no intraperitoneal injections given.
Joho H.	3½	6½	.....	Slight distention	+	Polynucleors, 14 per cent; lymphocytes, 86 per cent	
Cotherioe O'L.	3½	6½	.....	Soft; oot distended	+	290 cells per c.mm.; polynucleors, 81 per cent; lymphocytes, 19 per cent	
Cynthia L.	4½	6½	Rickets; tuberculosis suspected	Slight distention	+	860 cells per c.mm.; polynucleors, 9 per cent; lymphocytes, 91 per cent	
William W.	3½	5	.....	Slight distention	+	1700 cells per c.mm.	
Joseph B.	5	4½	.....	.....	+	630 cells per c.mm.; polynucleors, 20 per cent; lymphocytes, 80 per cent	
Aug. 18, 1920	5	4½	.....	.....	+	2300 cells per c.mm.; polynucleors, 4 per cent; lymphocytes, 75 per cent; "epithelial," 21 per cent	
Oct. 11, 1920	7	5½	Bronchopneumocoin	.....	+	

rence of a large ascites could have been constantly overlooked in all the previous careful pathological studies. Our own autopsy protocols during the past months, when our interest was centered on this question, do not record appreciable quantities of peritoneal fluid in marantic infants. And, indeed, the results reported here do not imply the presence of a large ascites. This method—the use of the capillary tube—demonstrates very slight deviations from the normal. In the normal infant no fluid can be found by this procedure,⁶ and under conditions simulating an effusion, Denzer and Anderson have found that the capillary tube shows the presence of from 5 to 15 cc of free peritoneal fluid.⁷ Furthermore, there is no evidence clinically of a large ascites; neither fluid wave nor shifting dullness could be elicited in our marantic infants. Thus all the available data suggest that the transudate demonstrated by the capillary tube in marantic infants is extremely small.

The clinical significance of this transudate is not apparent. There is no relation between the occurrence of fluid and the severity of the disease. Likewise, there are no constant physical findings associated with the presence of an ascites. As mentioned previously, there is not sufficient fluid to produce the usual signs of ascites, nor can distention be correlated with the peritoneal transudate. In only one case in which a positive tap was obtained had an intraperitoneal injection been done prior to the puncture.⁸ However, the ascites is sufficiently constant to be considered part of the pathological picture of marasmus.

Speculation as to the role which ascites plays in marasmus would involve the whole question of its pathogenesis, and that in turn the complicated problem of water metabolism. Such speculation would probably be fruitless, and it therefore seems advisable merely to record the fact that in a certain percentage of marantic infants an excess of peritoneal fluid is found.

Rickets. In 4 of 8 cases of rickets abdominal tap showed the presence of fluid in the peritoneal cavity (Chart II). In one case (Marie O'D.) the glass needle was used and 1 cc of fluid collected. The cells range in number from 100 to 1000. A differential smear shows a predominance of lymphocytes; the microscopic picture, however, is not characteristic and cannot be distinguished from that found in marantic infants.

The series is not sufficiently large to warrant conclusions concern-

⁶ Writers on the anatomy and physiology of the peritoneum agree that there is merely enough peritoneal fluid to lubricate the abdominal contents—that normally there is no "free" peritoneal fluid. Indeed, no analyses of "normal" peritoneal fluid have ever been made because it is impossible to collect enough for chemical examination.

⁷ The Absorption of Fluid Injected into the Peritoneal Cavity, *Am. Jour. Dis. Children*, June 2, 1921, 21, 565.

⁸ Agnes H. received an intraperitoneal injection three weeks prior to the first positive tap.

ing the cause of the ascites. The occurrence of pot-belly in most of the cases that showed free fluid suggests that the mechanical and circulatory derangement incident to the large abdomen may play some part in the development of the ascites. However, this is merely an impression, and further work will be necessary both to determine the incidence of free fluid in rickets and to explain its pathogenesis.

CHART II.—ABDOMINAL TAP IN RICKETS.

Name.	Age.	Weight.	Pot belly.	Result of tap.	Cell count.
Isaac S. . . .	11	14½	Very slight	+	Small amount; enough for few smears only.
Stewart, S. . . .	5	11½	None	0	
David D. . . .	4	27	None	0	
Arnold M. . . .	19	....	Moderate	0
Doris J. . . .	17	17	Very slight	0	
Mario O'D. Sept. 20, 1920	6	8½	Very marked	+	350 cells per c.mm.; lymphocytes, 85 per cent; polynuclears, 15 per cent.
Mar. 10, 1921	11	....	Very marked	0
Leon T. . . .	4	9½	0	+	1000 cells per c.mm.; lymphocytes, 95 per cent; polynuclears, 5 per cent.
Hazel R. . . .	8	11	Marked	+	

Summary. Five cases of peritonitis are presented in which abdominal puncture and the capillary tube were of service in establishing the diagnosis. The same method has revealed free fluid in the peritoneal cavity of cases of rickets and marasmus, a finding which, as far as I have been able to determine, has not been recorded previously. These observations on peritoneal inflammations and transudates are not numerous enough to warrant sweeping generalizations. They are important because they indicate that a procedure which demonstrates minute amounts of fluid in the peritoneal cavity may be helpful in answering many questions of practical and experimental interest—the initial response of the peritoneum to infectious and other irritants, the question of peritoneal absorption and the therapeutic use of sera in pneumococcal infections. The method of abdominal puncture with the use of the capillary tube has passed the experimental stage; a larger experience is necessary to disclose its possibilities and define its limitations.

I wish to thank Dr. A. F. Anderson and Dr. D. B. Witt, respectively resident and assistant resident physicians at the New York Nursery and Child's Hospital, for their kind coöperation in the selection of some of the cases and the performance of the punctures.